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ABSTRACT

This report presents outcome data on infant motor activity and behavioral state. Subjects were 45 infants who had birth weight of less than 1,501 grams, were appropriate for gestational age, and were free of major complications. A total of 21 infants were studied during a preintervention (control period), and 24 were studied in a posttraining (study period). Staff nurses were trained to: (1) lower light and noise levels and create diurnal patterning; (2) support motor development by maintaining flexed posture and by containing diffuse activity; (3) support behavioral state organization by protecting sleep periods; (4) facilitate feeding by offering a pacifier during gavage feeding; and (5) reduce procedural stress by pacing interventions and providing containment. Unit organization was monitored weekly. Light and noise levels were measured biweekly. Infant and nurse behavior were sampled at 30-second intervals during biweekly 18-minute observations of routine care. Results demonstrated that developmental care can improve both behavioral organization and medical and growth outcomes. It is concluded that the positive effects for motor activity and behavioral state have special relevance for social and cognitive development. (RH)

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CONFERENCE SUMMARY

Reducing the Stress of Intensive Care: Effects on Motor and State Behavior

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Abstract

Numerous aspects of the neonatal intensive care unit, including handling for routine care as well as light and noise levels, are known to be stressful for low birth weight infants. This stress may contribute to continuing morbidity. We have previously reported improved medical and growth outcomes and more positive behavioral organization for infants receiving nursing care designed to reduce these stressors. The purpose of this report is to present additional outcome data on infant motor activity and behavioral state.

Twenty-one infants of birth weight less than 1501 grams, appropriate for gestational age and free of major complications, were studied pre-intervention (control period); 24 infants were studied post-training (study period). Staff nurses were trained in protocols designed to 1) lower light and noise levels, create diurnal patterning; 2) support motor development by maintaining flexed posture and containing diffuse activity; 3) support behavioral state organization by protecting sleep periods; 4) facilitate feeding by offering pacifier during gavage feeding; and 5) reduce procedural stress by pacing interventions and providing containment. NICU organization (staffing, policies) was monitored weekly. Light and noise levels were measured biweekly. Infant and nurse behavior was sampled at 30-second intervals during biweekly 18- minute observations of routine care. Measures of nurse behavior include: 1) light and noise levels, and 2) frequency of facilitative behaviors (containment, postural support, offering pacifier). Measures of infant behavior include quality of motor movement (organized flexor, disorganized jerky, and total movement) and distribution of behavioral states (active sleep, alert wakefulness, and non-alert wakefulness).

Results showed no differences for NICU organization. Nurse behavior changed significantly: light and noise levels were reduced, diurnal light patterns were strengthened, and frequency of facilitative behaviors increased. Total movement did not differ, but frequency of jerky movements decreased and flexor movements increased. Percent of active sleep and non-alert wakefulness did not differ, but percent of alert wakefulness was higher by 34 weeks GA.

Results demonstrate that developmental care can improve both behavioral organization and medical and growth outcomes. The positive effects for motor activity and behavioral state have especial relevance for social and cognitive development. Results support previous findings, and suggest the potential for reducing longterm developmental morbidity.

Presented at the Society for Research in Child Development, Seattle, WA, April 1991.

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Reducing the Stress of Intensive Care: Effects on Motor and State Behavior

Introduction

Numerous aspects of the neonatal intensive care unit, including handling for routine care as well as light and noise levels, are known to be stressful for low birth weight infants (Wolke, 1987). It is postulated that this stress may contribute to continuing morbidity (Duffy, Mower, Jensen & Als, 1984). We have previously reported improved neurobehavioral and growth outcomes and more positive behavioral organization for infants receiving nursing care designed to reduce these stressors (Becker, Grunwald, Moorman & Stuhr, in press). The purpose of this report is to present additional outcome data on infant motor activity and behavioral state. The research questions were:

1) Will infants receiving 'developmental' care (study) show more organized motor activity and less disorganized motor activity during routine care than infants not receiving developmental care (control)?

2) Will Study infants spend more time during routine care in low arousal states (active sleep and alert) than in high arousal states (active wake and fuss/cry)?

Method

Design

A phase-lag design was used to evaluate change in outcome variables before and after implementation of developmental care. Progress for 21 infants was monitored until the last infant was discharged (control period). The nursing staff was then given an education program and developmental nursing care protocols were implemented, following which a second group of 24 infants was monitored until the discharge of the last subject (study period).

Subjects

Subjects were 45 infants and nursing staff of an 18-bed NICU in a tertiary care center in a small city in the mid-west. Infants included in the study had a birth weight less than 1501 grams, were appropriate for gestational age, and free of major chromosomal anomalies or congenital defects. Eligible infants were enrolled consecutively as they were admitted to the NICU. Informed consent was obtained from the parents during the latter half of the first week of the infant's hospitalization; only one family refused consent for participation. One infant was dropped because of early transfer to the pediatric unit due to overcrowding in the NICU; an additional 6 infants were dropped because they had been experimental subjects in a concurrent double blind clinical trial of surfactant therapy. There were 5 multiple births in the control group and 3 in the experimental group. All but two infants were from intact 2-parent families, and the majority of parents were Caucasian and had at least a high school education (Table 1).

Measures and Procedures

Demographic measures. Parents' marital status and education were obtained by questionnaire. Gestational age (GA), Apgar scores, and birth weight were obtained from medical records.

NICU Organization. Administrative variables that could have biased the results included changes in policies and procedures, patient/staff ratio, the number of primary care nursing assignments, and number of personnel in the nursery (activity level).

Intervention: Nursing staff education in the behavior and development of the premature infant was accomplished using the Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) developed by Als and Gibes (1986), and follow-up inservices and crib-side training by the unit's neonatal clinician and occupational therapist. Staff were trained in protocols to:

1) lower light and noise levels, create diurnal pattern
2) support motor development: maintain flexed posture, contain activity
3) support behavioral state organization: protect sleep periods
4) support feeding: offer pacifier during gavage feeding
5) reduce procedural stress: pace interventions, provide containment

Nurse behavior. To evaluate whether practice was changed as a result of the education program, measures were taken of the frequency of nurse actions designed to facilitate the infant's physiological and behavioral organization during care procedures, and of the light and noise environment. Coding categories for nurse behavior included nurse location, caregiving activity, facilitating actions, non-caretaking touch, vocalization, and attention. The measure used for this report was the mean number of discrete facilitating actions that occurred during 18 minutes of caregiving activity, including provision of physical support, containment with hands or swaddling, provision of aids for self regulation, support for flexed positioning, and offer of pacifier. Interrater reliability for this measure ranged from .79 to .90.

Light levels (lux) and noise levels (dB, A-weighted scale) were assessed with an AEMC 189.100 broad range remote sensor light meter and a Bruel & Kjaer model 2203 sound meter, respectively. The meters were recalibrated periodically per manufacturers' instructions. Each observation was also rated for light and noise levels at the incubator or crib, with 1 representing low and 7 very high levels.

Infant Outcome Measures.

Measures previously reported include: medical and growth measures (morbidity, respiratory status, feeding progression, presence IVH, length hospitalization) obtained from chart review, and behavioral organization, assessed with the Brazelton Neonatal Assessment Scales (NBAS) (Brazelton, 1984), administered during the week before discharge.

Measures for this report include behavioral state and motor activity. Behavioral state was judged on the basis of eye movement, activity level, respiratory characteristics, muscle tone, and vocalizations (Becker & Thoman, 1983). States included quiet sleep, active sleep, sleep-wake transition, drowse/daze, non-alert active awake, alert, and fuss cry. Measures used for analysis include active sleep, wake-not alert, and wake-alert.

Motor movements were recorded as they occurred. Categories included large, intermediate and small movements, jerks/startles, tremors/twitches, extensor movements (digits, limbs, or whole body arching), and flexor movements (grasping, hand to mouth or face, leg bracing). Measures used for this report include jerky movements and modulated flexor movements.

Interrater reliability of 70% or above in coding state and motor behavior was established before the study and checked periodically throughout data collection.

Procedures

NICU organization measures were recorded weekly. Light and noise levels were recorded biweekly at room center and inside the isolette or crib at each corner of the room, alternating day (6 A.M. to 6 P.M.) and night. Each infant was observed biweekly for 18 minutes of routine care procedures, alternating mornings and evenings. The observer recorded behavioral state at 30 second intervals, timed by an electronic timer. Nurse behaviors and infant motor behavior were recorded as they occurred.

Results

Differences between groups were tested with two-tailed t-tests for two means and chi square analysis, as appropriate.

Demographic variables. Groups did not differ on measures of either parent status (parent education and ethnicity) or initial infant status (birth weight, gestational age, and Apgars at 1 and 5 minutes) (Table 1). In addition, there were no differences in level of morbidity for the first week of hospitalization.

NICU Organization. Approximately two-thirds of the way through the study period the gavage feeding protocol was changed from nasogastric to orogastric feedings for two different months, at the preference of one of four neonatologists, but there were no other changes in unit protocols. Staff/patient ratios remained relatively constant, and there were no differences in either the mean number of primary care assignments per week or activity levels (number of persons in each room).

Nurse Behavior. Light levels were lowered in both the intensive care and convalescent care nurseries. A diurnal pattern was present in the convalescent room and was strengthened. No diurnal pattern was present in the intensive care room, nor was one established. Noise levels were lowered in each room but diurnal patterns were not established. Nurse facilitating behavior increased significantly (Table 2)

Infant Medical and Growth Measures (corrected for birthweight): (Table 3). Results reported previously indicated that level of morbidity during the first 4 weeks was lower, time to complete nipple feed was shorter, and length of hospitalization was two weeks shorter for the study infants. Days on ventilator tended to be fewer, but there was no difference in days on oxygen. There were too few instances of IVH for statistical comparison (IVH: Grades I-II: Control 3, Study 4; Grades III-IV: Control 1, Study 0).

Infant Behavior: Data reported represent observations at 30, 32, and 34 weeks gestational age (Table 4).

There were no group differences in total amount of motor activity at any age. The number of jerky movements was lower for Study than Control infants at 30 and 32 weeks, and decreased across age for both groups. The number of modulated movements was higher for Study than Control infants at each age.

Groups did not differ in either the amount of Active Sleep or Wake Not-Alert. There was a decrease across time for both groups in Active Sleep. There was an increase across age in Wake-Alert for both groups, and a significantly higher frequency of Wake-Alert for the Study group by 34 weeks. The frequency of Fuss/Cry was too low for comparison.

Behavioral organization as measured by the NBAS showed more optimal Total Score for the Study group, and a trend towards more optimal Reflex and Self-Regulation scores, as reported earlier.

Conclusions

Results demonstrate that a developmental approach to nursing care of very low birth weight infants can be successfully implemented in the NICU, and can improve both behavioral organization and medical and growth outcomes. The positive effects for motor activity and behavioral state in particular have important implications for both social and cognitive development. Results support previous findings based on more selective implementation of developmental care (Als et al., 1986), and suggest that this approach may contribute to reductions in long term developmental morbidity.

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Table 1. Sample Characteristics

	Control (N = 21)		Study (N = 24)	
	M	sd	M	sd
Mother's education [a]	2.93	.88	2.72	1.02
Gestational age (weeks)	28.38	1.28	29.00	1.93
Apgar. 1 Min.	4.85	2.11	5.33	2.28
Apgar. 5 Min.	6.68	1.49	7.12	2.05
Birthweight (grams)	1199.10	159.66	1208.54	222.94
Morbidity - Week 1	8.43	3.40	7.29	4.13

Table 1. Sample Characteristics (continued)

	n	%	n	%
Gender of Infant				
Female	7	33%	12	50%
Male	14	67%	12	50%
Ethnicity				
Caucasian	18	86%	20	83%
Black	2	10%	3	13%
Asian	1	4%	1	4%
Multiple Birth	5	24%	3	13%

Note. Groups did not differ on any measure.

[a]Scored: 1 = < high school; 2 = high school or GED; 3 = technical school or some college; 4 = college or more.

Table 2. Change in Nurse Facilitating Behavior from Control to Study Period for Observations at 30, 32, and 34 Weeks Gestational Age (GA)

Variable	F Period (df 1,34)	F GA (df 2,68)	F P x GA (df 2,68)	Contrasts
Containment	13.78···	ns	ns	Control < Study
Postural Support	440.29···	9.35···	6.39··	Control < Study 34 < 30,32: Study
Pacifier	ns	3.03′	3.68·	Control < Study: 34
Total Number Facilitating Behaviors	9.56··	ns	ns	Control < Study

′p < .10. ·p < .05. ··p < .01. ···p < .001.

Table 3. Medical Status, Growth, and Behavioral Assessment[a] Outcome Measures, Corrected for Birth Weight

	Control (n = 21)		Study (n = 24)		
Outcome Measures	M	sd	M	sd	t value[b]
Morbidity[c] - 1st 4 weeks	6.67	3.39	4.66	3.37	1.99·
Days on ventilator	12.43	17.22	5.45	9.04	1.67′
Days on oxygen	35.86	36.96	22.54	30.92	1.32
Complete oral feed (days)	48.85	16.09	38.00	17.77	2.14·
Hospitalization (days)	66.86	22.80	53.17	22.26	2.04·
NBAS Total Score	118.10	12.60	127.50	15.61	2.13·
NBAS Reflex Score	0.10	0.08	0.06	0.06	1.67′
NBAS Self-Regulation	4.47	1.29	5.13	0.97	1.64′

Note. All values in predicted direction.

[a]Neonatal Behavioral Assessment Scale (NBAS). [b]Two-tailed test. [c]Neonatal Morbidity Scale (Minde et al., 1983), low scores more optimal.

′$p < .10$. ·$p < .05$.

Table 4. Infant Behavior during Caretaking at 30, 32, and 34 Weeks Gestational Age (GA)

Outcome Measure	F Group (df 1,34)	F GA (df 2,68)	F G x GA (df 2,68)	Contrasts
Total Movement	ns	ns	ns	--
Jerky Movement	10.85··	6.06·	4.87··	Control > Study: 30,32 30 > 32 > 34
Flexor Movement	5.41·	ns	ns	Control < Study
Active Sleep	ns	7.00··	ns	30 > 32 > 34
Wake-Not-Alert	ns	ns	ns	--
Wake-Alert	4.30·	9.34···	4.32·	Control < Study: 34 30 < 32 < 34

·$p < .05$. ··$p < .01$. ···$p < .001$.